

## **Appendix B. Acute, 8-Hour, and Chronic Reference Exposure Levels (RELs) Summary Table**

**B.1 Introduction to Reference Exposure Levels Summary Table**

The acute noncancer Reference Exposure Levels (RELs) originally appeared in the “*Air Toxics Hot Spots Program Risk Assessment Guidelines Part I: The Determination of Acute Reference Exposure Levels for Airborne Toxicants*” March 1999 (OEHHA 1999a). Chronic noncancer RELs were presented in a subsequent publication: “*Air Toxics Hot Spots Program Risk Assessment Guidelines Part III: Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels*” (OEHHA 2000). Existing acute and chronic RELs have undergone public review and peer review by the State’s Scientific Review Panel (SRP) on Toxic Air Contaminants (TACs). The proposal to develop 8-hour RELs is presented for the first time in this document.

OEHHA develops chronic inhalation RELs for chemicals on the list of substances for which emissions need to be quantified (see Appendix C) under the Air Toxics Hot Spots Program. These substances are selected primarily based on:

- (1) the magnitude of current known emissions in California and
- (2) the availability of a scientific database on which to estimate a chronic REL.

RELs for acrolein, acetaldehyde, arsenic, formaldehyde, manganese, and mercury have been developed using these new guidelines, and were approved by the SRP and adopted by OEHHA. These new RELs are listed here. This table also lists RELs developed using the original (OEHHA 1999a and 2000) methodologies. In addition, the California Air Resources Board (ARB) previously adopted chronic RELs for acetaldehyde, diesel exhaust particulates, and perchloroethylene during the identification of these substances as TACs. Risk assessors should continue to use these existing values, until such time as they are replaced by newly developed values. Prioritization for updating these original values will follow the scheme presented in the *Prioritization of Toxic Air contaminants under the Children’s environmental Health Protection Act* (OEHHA, 2001).

<b>TABLE B.1.1. OEHHA ACUTE, 8-HOUR AND CHRONIC REFERENCE EXPOSURE LEVEL (REL) SUMMARY<sup>1</sup></b>					
<b>Substance</b>	<b>REL type<sup>[1]</sup></b>	<b>Inhalation REL (µg/m<sup>3</sup>)</b>	<b>Oral REL (µg/kg BW-day)</b>	<b>Hazard Index Target Organs</b>	<b>Species<sup>[2]</sup></b>
<b>Acetaldehyde</b> (75-07-0)	<b>A</b>	470 <sup>[5]</sup>		Eyes, respiratory system (Sensory irritation)	H
	<b>8</b>	300 <sup>[4,5]</sup>		Respiratory system	R
	<b>C</b>	140 <sup>[4,5]</sup>		Respiratory system	R
<b>Acrolein</b> (107-02-8)	<b>A</b>	2.5 <sup>[5]</sup>		Eyes, respiratory system (Sensory irritation)	H
	<b>8</b>	0.7 <sup>[5]</sup>		Respiratory system	R
	<b>C</b>	0.35 <sup>[5]</sup>		Respiratory system	R
<b>Acrylic Acid</b> (79-10-7)	<b>A</b>	6,000		Respiratory system	R
<b>Acrylonitrile</b> (107-13-1)	<b>C</b>	5 <sup>[4]</sup>		Respiratory system	R
<b>Ammonia</b> (7664-41-7)	<b>A</b>	3200 <sup>[4]</sup>		Respiratory system; eyes	H
	<b>C</b>	200		Respiratory system	H
<b>Arsenic</b> (7440-38-2) & <b>inorganic arsenic compounds (including arsine)</b>	<b>A</b>	0.20 <sup>[5]</sup>		Development (teratogenicity); cardiovascular system; nervous system	M
	<b>8</b>	0.015 <sup>[5]</sup>		Development; cardiovascular system; nervous system; lung; skin	H
	<b>C</b>	0.015 <sup>[5]</sup>	0.0035 <sup>[5]</sup>	Development; cardiovascular system; nervous system; lung; skin	H
<b>Benzene</b> (71-43-2)	<b>A</b>	1,300		Reproductive/ Developmental	R
	<b>C</b>	60		Hematologic & nervous systems; development	H
<b>Benzyl Chloride</b> (100-44-7)	<b>A</b>	240		Respiratory system; eyes	M, R
<b>Beryllium &amp; compounds</b> (7440-41-7)	<b>C</b>	0.007	2.0	Respiratory system; immune system	H
<b>Butadiene</b> (106-99-0)	<b>C</b>	20 <sup>[4]</sup>		Reproductive system	M
<b>Cadmium &amp; compounds</b> (7440-43-9)	<b>C</b>	0.02	0.5	Kidney; respiratory system	H

<b>TABLE B.1.1. OEHHA ACUTE, 8-HOUR AND CHRONIC REFERENCE EXPOSURE LEVEL (REL) SUMMARY<sup>1</sup></b>					
<b>Carbon disulfide (75-15-0)</b>	<b>A</b>	6,200		Reproductive/ Developmental	R
	<b>C</b>	800 <sup>[4]</sup>		Nervous system; reproductive system	H
<b>Carbon monoxide (630-08-0)</b>	<b>A</b>	23,000		Cardiovascular system	H
<b>Carbon tetrachloride (56-23-5)</b>	<b>A</b>	1,900		Reproductive/ Developmental	R
	<b>C</b>	40		Alimentary and nervous systems; development	GP
<b>Chlorinated dioxins (1746-01-6) and dibenzofurans (5120-73-19)</b>	<b>C</b>	0.00004	1 x 10 <sup>-5</sup>	Alimentary (liver) reproductive, endocrine, respiratory, hematopoietic systems; development	R
<b>Chlorine (7782-50-5)</b>	<b>A</b>	210		Respiratory system	H
	<b>C</b>	0.2 <sup>[4]</sup>		Respiratory system	R
<b>Chlorine dioxide (10049-04-4)</b>	<b>C</b>	0.6		Respiratory system	R
<b>Chlorobenzene (108-90-7)</b>	<b>C</b>	1,000		Alimentary system; kidney; reproductive system	R
<b>Chloroform (67-66-3)</b>	<b>A</b>	150		Reproductive/ Developmental	R
	<b>C</b>	300		Alimentary system; kidney; development	R
<b>Chloropicrin (76-06-2)</b>	<b>A</b>	29		Respiratory system	M
	<b>C</b>	0.4 <sup>[4]</sup>		Respiratory system	M
<b>Chromic trioxide (as chromic acid mist)</b>	<b>C</b>	0.002	20	Respiratory system	H
<b>Chromium hexavalent: soluble except chromic trioxide</b>	<b>C</b>	0.2 <sup>[4]</sup>	20	Respiratory system	R
<b>Copper and compounds</b>	<b>A</b>	100		Respiratory system	H
<b>Cresol mixtures (1319-77-3)</b>	<b>C</b>	600		Nervous system	R
<b>Dichlorobenzene (1,4-) (106-46-7)</b>	<b>C</b>	800		Nervous , respiratory and; alimentary systems; kidney	R
<b>Dichloroethylene (1,1) (75-35-4)</b>	<b>C</b>	70		Alimentary system (liver)	GP
<b>Diesel Exhaust</b>	<b>C</b>	5 <sup>[4,5]</sup>		Respiratory system	R

<b>TABLE B.1.1. OEHHA ACUTE, 8-HOUR AND CHRONIC REFERENCE EXPOSURE LEVEL (REL) SUMMARY<sup>1</sup></b>					
<b>Diethanolamine</b> (111-42-2)	<b>C</b>	3		Respiratory and cardiovascular systems	R
<b>Dimethylformamide (N,N-)</b> (68-12-2)	<b>C</b>	80		Alimentary and respiratory systems	H
<b>Dioxane (1,4-)</b> (123-91-1)	<b>A</b>	3,000		Respiratory system; eyes	H
	<b>C</b>	3,000		Alimentary system; kidney; cardiovascular system	R
<b>Epichlorohydrin</b> (106-89-8)	<b>A</b>	1,300		Respiratory system; eyes	H
	<b>C</b>	3		Respiratory system; eyes	R
<b>Epoxybutane (1,2-)</b> (106-88-7)	<b>C</b>	20		Respiratory system; cardiovascular system	M
<b>Ethylbenzene</b> (100-41-4)	<b>C</b>	2,000		Development; alimentary system (liver); kidney; endocrine system	M, R
<b>Ethyl chloride</b> (75-00-3)	<b>C</b>	30,000		Development; alimentary system	M
<b>Ethylene dibromide</b> (106-93-4)	<b>C</b>	0.8		Reproductive system	H
<b>Ethylene dichloride</b> (107-06-2)	<b>C</b>	400		Alimentary system (liver)	R
<b>Ethylene glycol</b> (107-21-1)	<b>C</b>	400		Respiratory system; kidney; development	H
<b>Ethylene glycol monobutyl ether</b> (111-76-2)	<b>A</b>	14,000		Respiratory system; eyes	H
<b>Ethylene glycol monoethyl ether</b> (110-80-5)	<b>A</b>	370		Reproductive/ Developmental	R
	<b>C</b>	70		Reproductive system; hematopoietic system	Rb
<b>Ethylene glycol monoethyl ether acetate</b> (111-15-9)	<b>A</b>	140		Reproductive/ Developmental	R
	<b>C</b>	300		Development	Rb
<b>Ethylene glycol monomethyl ether</b> (109-86-4)	<b>A</b>	93		Reproductive/ Developmental	R
	<b>C</b>	60		Reproductive system	Rb
<b>Ethylene glycol monomethyl ether acetate</b> (110-49-6)	<b>C</b>	90		Reproductive system	Rb
<b>Ethylene oxide</b> (75-21-8)	<b>C</b>	30		Nervous system	R

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<b>Fluorides</b> (except Hydrogen Fluoride - listed here separately)	<b>C</b>	13 <sup>[4]</sup>	40	Bone and teeth; respiratory system	H
<b>Formaldehyde</b> (50-00-0)	<b>A</b>	55 <sup>[5]</sup>		Sensory irritation; eyes	H
	<b>8</b>	9 <sup>[5]</sup>		Respiratory system	H
	<b>C</b>	9 <sup>[5]</sup>		Respiratory system	H
<b>Glutaraldehyde</b> (111-30-8)	<b>C</b>	0.08 <sup>[5]</sup>		Respiratory system	M
<b>Hexane (n-)</b> (110-54-3)	<b>C</b>	7000		Nervous system	H
<b>Hydrazine</b> (302-01-2)	<b>C</b>	0.2		Alimentary system; endocrine system	Ha
<b>Hydrogen chloride</b> (7647-01-0)	<b>A</b>	2,100		Respiratory system; eyes	H
	<b>C</b>	9		Respiratory system	H
<b>Hydrogen cyanide</b> (74-90-8)	<b>A</b>	340		Nervous system	H
	<b>C</b>	9		Nervous system; endocrine system; cardiovascular system	H
<b>Hydrogen fluoride</b> (7664-39-3)	<b>A</b>	240		Respiratory system; eyes	H
	<b>C</b>	14 <sup>[4]</sup>	40	Bone and teeth; respiratory system (See “fluorides” summary)	H
<b>Hydrogen selenide</b> (7783-07-5)	<b>A</b>	5		Respiratory system; eyes	GP
<b>Hydrogen sulfide</b> (7783-06-4)	<b>A</b>	42		Respiratory system	H
	<b>C</b>	10		Respiratory system	M
<b>Isophorone</b> (78-59-1)	<b>C</b>	2,000		Development; liver	R, M
<b>Isopropanol</b> (67-63-0)	<b>A</b>	3,200		Kidney; development	H
	<b>C</b>	7,000		Kidney; development	R, M
<b>Maleic anhydride</b> (108-31-6)	<b>C</b>	0.7		Respiratory system	R, Ha, Mk
<b>Manganese</b> (7439-96-5) & <b>manganese compounds</b>	<b>8</b>	0.17 <sup>[4,5]</sup>		Nervous system	H
	<b>C</b>	0.09 <sup>[4,5]</sup>		Nervous system	H
<b>Mercury</b> (7439-97-6) & <b>inorganic mercury compounds</b>	<b>A</b>	0.6 <sup>[5]</sup>		Nervous system, development	R
	<b>8</b>	0.06 <sup>[5]</sup>		Nervous system, kidney, development	H
	<b>C</b>	0.03 <sup>[5]</sup>	0.16 <sup>[5]</sup>	Nervous system, kidney, development	H

<b>TABLE B.1.1. OEHHA ACUTE, 8-HOUR AND CHRONIC REFERENCE EXPOSURE LEVEL (REL) SUMMARY<sup>1</sup></b>					
<b>Methanol</b> (67-56-1)	<b>A</b>	28,000		Nervous system	H
	<b>C</b>	4,000 <sup>[4]</sup>		Development	M
<b>Methyl bromide</b> (74-83-9)	<b>A</b>	3900		Nervous system	H
	<b>C</b>	5		Respiratory system; nervous system; development	R
<b>Methyl chloroform</b> (71-55-6)	<b>A</b>	68,000		Nervous system	H
	<b>C</b>	1000		Nervous system	Gb
<b>Methylene chloride</b> (75-09-2)	<b>A</b>	14,000		Cardiovascular, nervous systems	H
	<b>C</b>	400		Cardiovascular system; nervous system	H
<b>Methylene dianiline (4,4'-)</b> (101-77-9)	<b>C</b>	20		Eyes; alimentary system (liver)	GP
<b>Methylene diphenyl isocyanate</b> (101-68-8)	<b>C</b>	0.7 <sup>[4]</sup>		Respiratory system	R
<b>Methyl ethyl ketone</b> (78-93-3)	<b>A</b>	13,000		Respiratory system; eyes	H
<b>Methyl isocyanate</b> (624-83-9)	<b>C</b>	1		Respiratory system; reproductive system	R
<b>Methyl <i>t</i>-butyl ether</b> (1634-04-4)	<b>C</b>	8,000		Kidney; eyes; alimentary system (liver)	R
<b>Nickel &amp; compounds</b> (except nickel oxide for chronic exposures)	<b>A</b>	6		Respiratory, immune systems	H
	<b>C</b>	0.05	50	Respiratory system; hematopoietic system	R
<b>Nickel oxide</b> (1313-99-1)	<b>C</b>	0.1	50	Respiratory system; hematopoietic system	R
<b>Nitric acid</b> (7697-37-2)	<b>A</b>	86		Respiratory system	H
<b>Nitrogen dioxide</b> (10102-44-0)	<b>A</b>	470		Respiratory system	H
<b>Ozone</b> (10028-15-6)	<b>A</b>	180		Respiratory system; eyes	H
<b>Perchloroethylene</b> (127-18-4) ( <i>syn. Tetrachloroethylene</i> ) <sup>[3]</sup>	<b>A</b>	20,000		CNS; respiratory system; eyes	H
	<b>C</b>	35		Kidney; alimentary system (liver)	M
<b>Phenol</b> (108-95-2)	<b>A</b>	5,800		Respiratory system; eyes	H
	<b>C</b>	200		Alimentary system; cardiovascular system; kidney; nervous system	R

<b>TABLE B.1.1. OEHHA ACUTE, 8-HOUR AND CHRONIC REFERENCE EXPOSURE LEVEL (REL) SUMMARY<sup>1</sup></b>					
<b>Phosgene</b> (75-44-5)	<b>A</b>	4		Respiratory system	R
<b>Phosphine</b> (7803-51-2)	<b>C</b>	0.8		Respiratory system; alimentary system; nervous system; kidney; hematopoietic system	M
<b>Phosphoric acid</b> (7664-38-2)	<b>C</b>	7 <sup>[4]</sup>		Respiratory system	R
<b>Phthalic anhydride</b> (85-44-9)	<b>C</b>	20		Respiratory system	H
<b>Propylene</b> (115-07-1)	<b>C</b>	3,000		Respiratory system	R
<b>Propylene glycol mono- methyl ether</b> (107-98-2)	<b>C</b>	7,000		Alimentary system (liver)	R
<b>Propylene oxide</b> (75-56-9)	<b>A</b>	3,100		Respiratory system; eyes	H
	<b>C</b>	30		Respiratory system	R
<b>Selenium</b> and selenium compounds (other than hydrogen selenide)	<b>C</b>	20	5	Alimentary system; cardiovascular system; nervous system	H
<b>Silica</b> (crystalline, respirable)	<b>C</b>	3 <sup>[4]</sup>		Respiratory system	H
<b>Sodium hydroxide</b> (1310-93-2)	<b>A</b>	8		Respiratory system; eyes; skin	H
<b>Styrene</b> (100-42-5)	<b>A</b>	21,000		Respiratory system; eyes	H
	<b>C</b>	900 <sup>[4]</sup>		Nervous system	H
<b>Sulfates</b>	<b>A</b>	120		Respiratory system	H
<b>Sulfur dioxide</b> (7446-09-5)	<b>A</b>	660		Respiratory system	H
<b>Sulfuric acid</b> (7664-93-9) [ <b>&amp; oleum, acute only</b> ]	<b>A</b>	120		Respiratory system	H
	<b>C</b>	1		Respiratory system	Mk
<b>Toluene</b> (108-88-3)	<b>A</b>	37,000		Respiratory, nervous systems	H
	<b>C</b>	300		Nervous system; respiratory system; development	R
<b>Toluene diisocyanates</b> (2,4- & 2,6-)	<b>C</b>	0.07		Respiratory system	H
<b>Trichloroethylene</b> (79-01-6)	<b>C</b>	600		Nervous system; eyes	H
<b>Triethylamine</b> (121-44-8)	<b>A</b>	2,800		Nervous system; eyes	H
	<b>C</b>	200		Eyes	R
<b>Vanadium pentoxide</b> (1314-62-1)	<b>A</b>	30		Respiratory system system	H
<b>Vinyl acetate</b> (108-44-8)	<b>C</b>	200		Respiratory system	R, M
<b>Vinyl chloride</b> (75-01-4)	<b>A</b>	180,000		CNS; respiratory system; eyes	H



**TABLE B.1.1. OEHHA ACUTE, 8-HOUR AND CHRONIC REFERENCE EXPOSURE LEVEL (REL) SUMMARY<sup>1</sup>**

<b>Xylenes</b> (1330-20-7): technical mixture of o-xylene (95-47-6), m-xylene (108-38- 3) and p-xylene (106-42-3).	<b>A</b>	22000		Nervous & respiratory systems; eyes	H
	<b>C</b>	700		Nervous & respiratory systems; eyes	H

**Footnotes:**

<sup>[1]</sup> REL types: **A** = acute, **8** = 8-hour, **C** = chronic. Exposure averaging time for acute RELs is 1 hour. For 8-hour RELs, the exposure averaging time is 8 hours, which may be repeated. Chronic RELs are designed to address continuous exposures for up to a lifetime: the exposure metric used is the annual average exposure.

<sup>[2]</sup> Species used in key study for REL development: D = dog; Gb = gerbil; GP = guinea pig; H = human; Ha = hamster; M = mouse; Mk = monkey; R = rat; Rb = rabbit

<sup>[3]</sup> These peer-reviewed chronic REL values were developed under the Toxic Air Contaminant (TAC) Program mandated by AB1807.

<sup>[4]</sup> REL based on benchmark dose (BMC) approach.

<sup>[5]</sup> REL developed using the revised methodology (OEHHA, 2008)]